AN ANALYSIS OF THE RELATIONSHIP AMONG MEDITATION, PERSONALITY TYPE AND CONTROL OF BRAIN WAVE PRODUCTION

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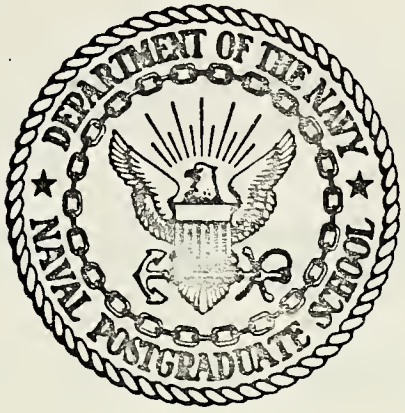

THESIS

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ABSTRACT

In recent years scientists in every nation have come to realize that voluntary control of behavior is of primary importance if we hope to establish an ordered society or even to maintain a society.

Meditation has been known and practiced by Asian people, especially Indians, for many hundreds of years. With the aid of the biofeedback technique, it is believed that the study of altered states of consciousness, creativity, parapsychology, personality type, psychosomatic medicine, therapy, and education, etc., could be greatly enhanced.

This paper is concerned with the interrelationship among meditation, personality type and brain wave production using biofeedback techniques.

Emphasis is placed on the effect of meditation on personality type changes.

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I. INTRODUCTION

This paper is concerned with the relationship among meditation, personality type, and control of brain wave production. It is necessary to have some background information concerning each of these areas of interest before one can understand the goals and results presented in this paper. Jung's theory of personality will be considered first.

A. JUNG'S THEORY OF PERSONALITY

Jung's theory of personality is usually identified as a psychoanalytic theory (Hall and Lindzey, 1960) because of the emphasis that it places upon unconscious processes. Perhaps the most prominent and distinctive feature of Jung's view of man is that it combines teleology with causality. Man's behavior is conditioned not only by his individual and racial history (causality) but also by his aims and aspirations (teleology). Both the past as actuality and the future as potentiality guide one's present behavior. Jung's theory is also distinguished from all other approaches to personality by the strong emphasis that it places upon the racial and phylogenetic foundations of personality. Jung's theory sees the individual personality as the product and container of its ancestral history. There is a racially preformed and collective personality which reaches out selectively into the world of experience and is modified and elaborated by the experiences that it receives. An individual's personality is a resultant of the interplay between inner forces and outer forces.

1. The Structure of Personality

The total personality consists of a number of separate but interacting systems. The principal ones are the ego, the personal unconscious and its complexes, the collective unconscious and its archetypes, the persona, the anima or animus, and the shadow. In addition to these independent systems there are the attitudes of introversion and extraversion, and the functions of thinking, feeling, sensing, and intuiting. Finally, there is the self which is the fully developed and fully unified personality.

Without entering into the details of the interdependent systems, we will describe briefly now the attitudes and functions which are intimately related to the study of this paper.

2. The Attitudes.

Jung distinguishes two major attitudes or orientations of personality called extraversion and introversion. The introverted attitude orients the person toward the inner, subjective world. The extraverted attitude orients the person toward the outer world of people and things.

These two opposing attitudes are both present in the personality but ordinarily one of them is dominant and conscious while the other is subordinate and unconscious. If the ego is predominantly extraverted in its relation to the world, the personal unconscious will be introverted.

3. The Functions.

There are four fundamental psychological functions: thinking, feeling, sensing and intuiting. Thinking is ideational and intellectual.

By thinking, man tries to comprehend the nature of the world and himself. Feeling is the value function. Feeling is the value of things with reference to the subject. The feeling function gives man his subjective experiences of pleasure and pain, of anger, fear, sorrow, joy and love. Sensing is the perceptual or reality function. It yields concrete or representation of the world. Intuition is perception by the way of unconscious processes and sublimal contents (Jung, 1923). The intuitive man goes beyond facts, feelings, and ideas. He constructs elaborate models of reality. Intuition enables one to get at the essence of reality.

Although a person has all four functions, they are not necessarily equally well developed. Usually one of the four functions is more highly differentiated than the other three, and plays a predominant role in consciousness. This is called the superior function. One of the three other functions usually acts in an auxiliary function to the superior function. If the superior function is prevented from operating, the auxiliary function automatically takes its place.

The least differentiated of the four functions is called the inferior function. It is repressed and unconscious. The inferior function also has an auxiliary associated with it.

4. Interactions Among the Systems of Personality.

The various systems and the attitudes and functions that go to make up the total personality interact with each other in three different ways. First, one system may compensate for the weakness of another system. Secondly, one system may oppose another system or third, two or more systems may unite to form a synthesis.

Compensation may be illustrated by the interaction of the contrasting attitudes of extraversion and introversion. If extraversion is the dominant or superior attitude of the conscious ego, then the unconscious will compensate by developing the repressed attitude of introversion. This means that if the extraverted attitude is frustrated in some way, the unconscious inferior attitude of introversion will seize hold of the personality and exert itself. A period of intense extraverted behavior is ordinarily followed by a period of introverted behavior. Dreams are also compensatory so that the dreams of a predominantly extraverted person will have an introverted quality, and conversely, the dreams of a predominantly introverted person will tend to be extraverted.

Compensation also occurs between functions. A person who stresses thinking and feeling in his conscious mind will be an intuitive, sensation type unconsciously. In general, all of the contents of the conscious mind are compensated for by the contents of the unconscious mind. The principle of compensation provides for a kind of equilibrium or balance contrasting elements which prevents the psyche from becoming neurotically unbalanced.

Jung believes that a psychological theory of personality must be founded on the principle of opposition or conflict because the tensions created by conflicting elements are the very essence of life itself. Without tension there would be no energy and consequently no personality. Opposition exists everywhere in the personality. Opposition exists between the ego and the shadow, between the persona and the personal

unconscious, between the collective unconscious and the ego, and between the collective unconscious and the persona. Introversion opposes extraversion; thinking opposes feeling; and sensation opposes intuition. The contest between the rational and irrational forces of the psyche never ceases. Conflict is a basic fact of life.

Polar elements not only oppose one another, they also attract or seek one another. The union of opposites is accomplished by what Jung calls the transcendent function. The operation of this function results in the synthesis of contrary system to form a balanced, integrated personality. The center of this integrated personality is in the self.

5. The Dynamic of Personality.

Jung conceives of the personality or psyche as being a partially closed energy system. It is said to be incompletely closed because energy from outside sources must be added to the system, for example, by eating. Energy is subtracted from the system, for example, by performing muscular work. It is also possible for environmental stimuli to produce changes in the distribution of energy within the system. This happens, for instance, when a sudden change in the external world reorients our attention and perception. The fact that the personality dynamics are subject to influences and modifications from external sources means that the personality cannot achieve a state of perfect stabilization, as it might be if it were a completely closed system. Jung's concept of dynamic of personality seems to be supported by Gordon W. Allport in his article "The open system in personality theory" (6). Allport stated:

"There is intake and output of both matter and energy; there is the achievement and maintenance of steady (homeostatic) so that the intrusion of outer energy will not seriously disrupt internal form and order.

... finally, at least at the human level, there is more than mere intake and output of matter and energy: there is extensive transactional commerce with the environment."

This is exactly what Jung stated about a partially closed energy system of personality.

6. Psychic Energy.

The energy by which the work of the personality is performed is called the psychic energy. Psychic energy is a manifestation of life energy which is the energy of the organism as a biological system. Psychic energy originates in the same manner as does all vital energy, namely from the metabolic processes of the body. Jung does not take a positive stand on the relation of psychic energy to physical energy but he believes that some kind of reciprocal action between the two is a tenable hypothesis.

Jung's concept of psychic energy is believed to be found application in the process of physiological control and biofeedback technique. Elmer E. Green, Alyce M. Green and E. Dale Walters (1971) said: "Our research program began with 33 housewives. They practiced autogenic exercises for only two weeks and at the beginning and end of their training experiences, we measured most of the physiological variables that were easy to get, such as brain waves, heart rate, breathing rate, skin potential, skin resistance, blood flow in the fingers, and the temperatures of both hands, front and back."

Psychic energy is a hypothetical construct, it is not a concrete substance or phenomenon. Consequently, it cannot be measured or sensed. Psychic energy finds concrete expression in the form of actual or potential forces. Wishing, filling, feeling, attending, and striving are examples of actual forces in the personality. Dispositions, aptitudes, tendencies, inclinations, and attitudes are examples of potential forces.

7. Psychic Values.

The amount of psychic energy installed in an element of the personality is called the value of this element. Value is a measure of intensity. When we speak of placing a high value upon a particular idea or feeling, we mean that the idea or feeling exerts a considerable force in instigating and directing behavior. A person who values truth will expend a great deal of energy on the search for it. One who places great value upon power will be highly motivated to obtain power. Conversely, if something is of trivial value, it will have little energy attached to it.

The absolute value of an idea or feeling cannot be determined, but its relative value can be. One simple way of determining relative values is to ask a person whether he prefers one thing more than another. The order of his preferences can be taken as a rough measure of the relative strengths of his values. This is essentially the principle used by Myers-Briggs Type Indicator which will be used by the author of this paper.

8. The Principle of Equivalence.

Jung bases his view of psychodynamics upon two fundamental principles, the principle of equivalence and that of entropy. The principle

of equivalence states that if energy is expended in bringing about a certain condition, the amount expended will appear elsewhere in the system. This is just the principle of conservation of energy as in physics. Applied to psychic functioning, this principle states that if a particular value weakens or disappears, the sum of energy represented by the value will not be lost from the psyche but reappear in a new value. The lowering of one value inevitably means the raising of another value. It is possible, of course, for the energy lost from one value to be distributed among several other values. These distributions of energy constitute the dynamic of personality.

9. The Principle of Entropy.

The principle of entropy or the second law of thermodynamics states that when two bodies of different temperatures are placed in contact with another, heat will pass from the hotter to the colder body. The principle of entropy as adapted by Jung to describe personality dynamics states that the distribution of energy in the psyche seeks an equilibrium or balance. Thus, to take the simplest case, if two values (energy intensities) are of unequal strength, energy will tend to pass from the stronger value into the weaker value until a balance is reached. However, since the psyche is not a closed system, energy may be added to or subtracted from either of the opposing values and upset the equilibrium. Although a permanent balance of forces in the personality can never be established, this is the ideal state towards which the distribution of energy always strives. This ideal state is the self, self actualization is the goal of psychic development.

The operation of the principle of entropy means that a weak system attempts to improve its status at the expense of a strong system. In so doing, it creates tension in the personality. The energy of the superior attitude, whether it be extraversion or introversion, tends to move in the direction of the inferior attitude. An overdeveloped extravert is under pressure to develop the introverted part of his nature. It is a general rule in Jungian psychology that any one-sided development of personality creates conflict, tension, and strain, and an even development of all the constituents of personality produced harmony, relaxation and contentment.

B. THE MYERS-BRIGGS TYPE INDICATOR (Isabel Briggs Myers, 1962).

In order to apply Jung's theory of personality, a method to determine personality must be devised. The Myers—Briggs Type Indicator is a tool designed to categorize type according to Jung's theory. It consists of about 160 or so questions which have been designed in such a way as to measure the person's preference in contrasted attitudes and functions.

1. The Four Preferences.

The Indicator contains separate indices for determining each of the four basic preferences which, under this theory, structure the individual's personality. Those four indices are:

TABLE I

Psychological Preferences

Index	Preference between	Affects individual's choice as
EI	Extraversion or introversion	Whether to direct perception and judgment upon environment or world of ideas.
SN	Sensing or intuition	Which of these two kinds of perception to rely on.

TABLE I (continued)

Index	Preference between	Affects individual's choice as
TF	Thinking or feeling	Which of these two kinds of judgment to rely on.
JP	Judgment or perception	Whether to use the judging or perception attitude for dealing with the environment.

EI, SN, TF, and JP are indices designed to point one way or the other, rather than scales designed to measure traits. What each is intended to reflect is a habitual choice between opposites, analogous to right-or-left handedness. Thus EI means E or I rather than E to I. The items of each index offer four choices involving the preference at issue. Responses pointing in opposite directions bear separate weights of 0, 1, or 2, enabling the evidence in each direction to be separately summed.

Persons with more points for E than for I are classes as extraverts and are said to have E scores, as E7, E13, etc. Those with more points for I than for E are classed as introverts and are said to have I scores as I7, I13, etc. Since EI score is based on the difference between the points for I and for E, any given person may have either an E score or an I score, but not both. The letter is considered the most important part of the score, as indicating which of the opposite sides of his nature the person prefers to use. Presumably, he has developed -- or can develop -- this side to a higher degree. For instance, E suggests that he enjoys outgoing with people and things more than he enjoys turning in with the world of concept and ideas. The letters from all four scores, each with corresponding implications, make up the type formula, such as ENFP, which describes an extraverted, intuiting, feeling, perceiving personality type.

The numerical portion of the scores shows how strongly the preference is reported, which is not necessarily the same thing as how strongly it is felt. On every index, the scores run in both directions from zero at the center, to the limit of a particular orientation or reported preference. Where the direction of the reported preference changes, the ranges are:

(Extraverting)	E53 .....0.....	I59	(Introverting)
(Sensing)	S67 .....0.....	N51	(Intuiting)
(Thinking)	T49 .....0.....	F51	(males) Feeling
(Thinking)	T61 .....0.....	F49	(females) Feeling
(Judging)	J55 .....0.....	P61	(Percepting)

The division of each index into two separate scales emphasizes the respectful recognition which type theory accords to opposite kinds of people. Each person is classified in positive terms, by what he likes, not what he lacks. The theory attaches no prior value to judgment to one preference as compared with another, but considers each one valuable and at times indispensable in its own field.

Quantitative interpretation of the scores should be confined mainly to (a) the likelihood that the preference has been correctly reported, and (b) the importance of the preference to the counselor. Both may reasonably be expected to increase with the strength of the scores. Any other quantitative interpretation should probably be limited to situations where there is specific experimented evidence of relationship to some criterion.

2. Descriptive Statistics.

The Indicator is designed primarily for the examination of differences between people of opposite preferences. Therefore, the statistics describing the Indicator scores of a sample should, on each index, describe the two groups to be compared, rather than the sample as a whole. The first fact needed is the frequency of each preference. From these data, inferences may be drawn as to whether the selective forces determining membership in the sample have any relation to type. If so, is the relation to the bare preference or to the strength of difference or both. The results obtained from this table appear to be creditable to the Indicator.

3. Reliability.

The problem of ascertaining the reliability of the Indicator is a thorny one. As with other tests, the experimentor is faced with the question of how much of any given result is the reliability of the Indicator and how much is the reliability of the person taking it. The potent but as yet unmeasurable variable of "type development" -- i.e., the extent to which the person actually has developed the process and the attitudes which he prefers -- enters every equation as an unknown quantity.

Investigation on reliability for various levels by the use of a logically-split-half procedure has been made by Isabel Briggs Myers (2). Each index has been split into halves, taking all available item statistics into consideration and pairing items that most resemble each other and

correlate most highly. The resulting X and Y halves should, therefore, "represent faithfully the total test in all significant respects," as Guilford recommends (2).

Table II shows split-half reliabilities obtained by applying the Spearman-Brown prophecy formula to obtained correlations between halves. It includes all samples for which scores have thus far been split. The items assigned to X and Y halves of each index are listed in Appendix A.

TABLE II

Split-half reliability of the Myers-Briggs personality type indices for various groups

Males	Jr. High School	# of Subjects	EI	SN	TF	JP
	Gifted 7th-9th	34	.85	.84	.81	.82
	Under-achieving 8th	30	.80	.75	.44	.71
	Sr. High School	100	.77	.70	.60	.79
	Mass. Non-Prep 12th	100	.79	.84	.76	.87
	National Merit Finalist	100	.85	.86	.82	.89
	College Brown	100	.81	.87	.86	.80
Females						
	Jr. High School Gifted 7th-9th	26	.81	.86	.84	.75
	Sr. High School Mass. Academic 12th	100	.82	.80	.77	.88
	Advanced 12th	37	.87	.85	.84	.94
	College Pembroke	100	.82	.87	.83	.84

These reliabilities appear creditable for the Indicator. It also has been found (Isabel Briggs Myers, 1962) that the Indicator and the Gray-Wheelwright personality test are reflecting exactly the same things, though with different reliabilities. This degree of agreement seems explicable in only two ways. The reasonable explanation is that both tests are reflecting the same basic realities, that is, the Jungian opposites which both were designed to reflect. If not, it must be assumed that not only did the authors of the Indicator miss their objective but so also did the Jungian analysts Gray and Wheelwright in exactly the same ways -- a coincidence which seems unlikely.

C. TRANSCENDENTAL MEDITATION.

1. Definition.

Transcendental Meditation (TM), like most yoga systems taught in the U.S., traces its roots back to the tradition of which Pantanjali's Yoga Sutras is the classic statement. TM is a departure from the main body of contemporary Yogic practices. Maharishi (1969, p. 470) defines the technique of TM as: "turning the attention inward in the subtler levels of a thought until the mind transcends the experience of the subtlest state of the thought and arrives at the source of thought... A thought-impulse starts from the silent creative centre within, as a bubble starts from the bottom of the sea. As it rises, it becomes larger,arriving at the conscious level of the mind, it becomes large enough to be appreciated as a thought, and from there it turns into speech and action."

Turning the attention inwards takes the mind from the experience of a thought at the conscious level to the finer states of the thought until the mind arrives at the source of thought.

2. TM and Introversion.

Recall that Jung has defined introversion as a turning inwards of the libido whereby a negative relation of subject to object is expressed. Introversion may possess either a more intellectual or more emotional character, just as it can be characterized by either intuition or sensation (Jung, 1923).

Jung's concept about introversion in conjunction with Maharishi's definition about TM lead us to the following hypothesis: Hypothesis 1: There is a relation between those practicing transcendental meditation and those expressing an attitude of introversion.

3. Physiological Effects of TM.

The vehicle for transcending the level of conscious thought is a "mantra." A mantra is a sound taken from Sanskrit and given the practitioner of TM by a trained teacher who instructed him in its use at an initiation. TM is practiced twice a day for 15 to 20 minutes, sitting in a comfortable position with the eyes closed. Unlike some other meditation systems, TM does not use concentration but rather "passive volition," as is used in Autogenic Feedback Training (Green et al, 1970) for control of the autonomic nervous sytem. Maharishi (p. 471) emphasizes that TM "is neither a matter of contemplation nor concentration. "The process of contemplation and concentration each hold the mind on the conscious

thinking level, whereas transcendental meditation systematically takes the mind to the source of thought, the pure field of creative intelligence."

There are systematic differences among meditation systems, but the consequences of these differences up to now are unexplored. Charles Tart (1969) points out that Zen monks do not habituate to external stimuli. This is a behavioral reflection of the essence of the two philosophies: Zen mindfulness of, and yogic renunciation of, the sensory world. Different philosophical doctrines may well give rise to distinctive meditation techniques, which result in disparate psychological and behavioral outcomes. Or, they may be all pathways to the same ultimate destination. One necessary area of investigation is the comparative study of meditation techniques: the prime question is whether differences in technique are "real" -- i.e., psychophysiologically consequential -- or whether structually different meditation techniques are functionally equivalent (Ouspensky, 1969). In his introduction to the section on meditation in Altered States of Consciousness, Charles Tart (1969) notes the mental health implications of the dramatic effects obtained with ordinary subjects practicing meditation. Despite these results, systematic investigation has been nil.

In 1934, Edmund Jacobson, a Chicago physician, proposed "a practical method of reducing the strains of modern living" in a best-selling book called You Must Relax. Jacobson later documented a number of cases (1964), covering the range of psychosomatic diseases, cured with his relaxation technique. This list is virtually duplicated by the survey of results of practicing TM, and includes ulcers, asthma, insomnia, epilepsy,

allergies, high blood pressure, migraine headaches, etc. Basing his technique on physiological studies of muscular tension, Dr. Jacobson proposed the principle that relaxation is the direct physiological opposite of tension. This is one of the notions on which behavior therapy is founded. The technique is "systematic desensitization" as practiced by Wolpe and Lazarus (1966).

Many investigators have found that Yoga and Zen meditation markedly reduce basal metabolism rates (Anand et al, 1961; Kasamatsu and Hirai, 1966; Akishige, 1968). In studying the physiological effects of TM, Wallace (1970) found a decrease in the volume of oxygen consumed to 20% below base rate; Allison (1965) found a reduction to 4-6 breath/minute from a base rate of 12-14, rises in skin resistance up to 500%, reduced blood pressure (20% and more according to Datey et al, 1969), with cardiac output reduced 25% and muscle activity reduced to zero. All these measures taken together indicate a relaxation more profound than that of deep sleep.

4. TM and Personality.

With the inward turning of attention in meditation, the meditator becomes aware of the random chaos characteristic of thoughts in the waking state. The train of thought is endless, stops nowhere, and has no destination. The meditator witnesses the flow of psychic events, plannings, decisions, hopes, fantasies, memories, yearnings, decisions, indecisions, observations, fear, scheming, guilt, calculations, exaltations, and so on. The whole contents of the mind compose the meditator's "desensitization

hierarchy." The above concepts lead us to the following hypothesis: Hypothesis 2: There is a positive correlation between meditation and personality.

5. TM and Alpha Production.

In reporting on operant control of the Electroencephalographic (EEG) alpha wave, Kamiya (1966) mentions that the state of consciousness associated with alpha (brain wave of 7 to 13 cycles per second) is one of "a general calming down of the mind." Thoughts interfere with maintenance of the alpha state. He also reports that his best subjects tend to be people that have practiced meditation in one form or another. An EEG study of Zen meditation (Kamatsu and Hirai, 1969) found that production of alpha was associated with proficiency at meditation and with number of years practicing. Some very proficient subjects, who had been practicing Zazen for more than 20 years, showed heavy alpha production which gave way to theta (brain wave of 4-6 cycles per second) trains. Yogis practicing ray-yoga who were tested in India (Anand et al, 1961) also showed the alpha rhythm. Wallace's (1970) study of TM found that during meditation alpha-wave activity predominates; some subjects showed EEG patterns similar to those found in twenty-year practitioners of Zazen. Thus, it is natural to make the following hypothesis: Hypothesis 3: Meditation will allow higher alpha production. Taking this finding in conjunction with those of lowered basal metabolism, lowered lactate level, etc., Wallace (1970) proposes the existence of "a fourth major state of consciousness," that special psychological state of rest and pure awareness one can reach in meditation.

Tart (1970, p. 37) refers to the phenomenological experience of this state as "The Void." The void is where the person's "identity is potentiality. He is aware of everything and nothing; his mind is absolutely quiet; he is out of time, out of space." A Tibetan description of the same state is given by Evens-Wentz (1969, p. 211): "In its true state, mind is naked, immaculate; not made of anything, being of the Voidness clear, vacuous, unimpeded, colourless, not realizable as a separate thing, but as the unity of all things, yet not composed of them; of one taste, and transcendent over differentiation."

D. BIOFEEDBACK TECHNIQUE AND THE CONTROL OF BRAIN WAVE PRODUCTION.

1. Abstract.

Biofeedback techniques are based on the principle that certain responses are made when informational feedback is received by the organism. These responses are adjusted, corrected, and modified as feedback is continually received until it is determined that a final goal has been achieved. This new field of research has important implications for the study of altered states of consciousness, creativity, parapsychology, and education (R. Davidson and S. Krippner, 1970).

2. Biofeedback and Alpha Production.

As mentioned in the TM section, the most widely investigated of all the brain waves is alpha. It usually averages about 30 microvolts and occurs most frequently in the human during the state of relaxed wakefulness (Lindsley, 1960). In a comprehensive review of the literature on

the physiological basis of the alpha wave (Anderson and Anderson, 1968), the thalamus was implicated as the structure exercising control over cortical alpha activity. There have been a number of early reports on the use of biofeedback system in the suppression and habituation of the alpha wave (e.g. Mulholland and Runnals, 1962), as well as still earlier reports on the classical conditioning of EEG alpha (e.g., Jasper and Shagass, 1941; Knott and Henry, 1941). These reports did not assess subjective states associated with the concurrent electrocortical activity nor did any of the previous studies attempt to enhance EEG alpha through instrumental learning procedures.

The first investigator to attempt the study of operant control of EEG alpha and associated changes in mental activity was Kamiya (1962, 1967, 1968 and 1969). Kamiya was first interested in the question of whether human subjects could be trained to discriminate the presence and absence of alpha. The subject was told that from time to time he would hear a bell ring once and when he heard it, he was to make a guess as to whether he was producing or not producing alpha. As soon as he made his response, the experimenter told him if he was correct. The results indicated that after several sessions of training, most subjects had increased their discrimination accuracy well above the 50 per cent chance level.

Kamiya (1967, 1968, 1969) then turned his attention to the question of whether subjects could exercise control over their alpha activity and produce this brainwave pattern by command. He constructed an automated biofeedback system which employed an electronic device which

would turn on a sinewave tone in the subject's room whenever the alpha-wave was present. The tone would cease as soon as the alpha wave disappears. Kamiya then conducted a number of experiments where he would tell the subject to turn the tone either on or off. In the first phase of this research, he only trained people to suppress their alpha, finding that six of his seven subjects were able to perform their task (Kamiya, 1969). In another experiment employing three conditions (an alpha generation condition, alpha suppression and a basal level rest period), Kamiya (1969) found a marked difference between generation and suppression. The basal level, however, was higher than the generation condition. These data, however, do not refute the fact that autonomic learning has occurred, for it is quite likely that basal level alpha can change (Crider, Schwartz and Schnidman, 1969). It should also be noted that the alpha during the generation trials was of a higher amplitude than the alpha present in the baseline periods. This indicates an increase in perceptual awareness (Wallace, 1970).

3. Alpha Production and Personality.

The verbal reports that Kamiya (1969) collected from his high alpha subjects are provocative. He indicates that besides the general feeling of pleasantness that all subjects describe, there seems to be "some kind of general relaxation of the mental apparatus, not necessarily relaxation in the motor system, but a kind of general calming-down of the mind" (p. 514). He further reports that critical faculties seem to cease during alpha abundance. Kamiya (1969) also speculates on the personality

characteristics associated with high and low alpha producers. He states that people with such a history of introspection and those who employ such words as "images," "dreams," and "feelings" in their vocabulary seem to be better at the alpha generation task than subjects who do not use these words. The above findings lead us to hypothesis 4: Alpha production has a positive correlation with personality type.

II. THE ANALYSIS

A. DESIGN.

In order to test the hypotheses, the four-group design was used:

	Meditation	No Meditation
Alpha Training	(Group 1)	(Group 3)
No Alpha Training	(Group 2)	(Group 4)

B. SELECTION OF SAMPLE.

Because of the substantial amount of time needed for the alpha training exercise, randomization of sample had to be given up. Instead, we asked for volunteers to participate in the study. The sample composition is as follows:

TABLE III

The Sample Composition

	Subject	Sex	Age	Education	TM Time
Group 1	1	M	26	College	10 months
(TM+AT)	2	M	30	College	14 mo.
	3	F	26	Hi. School	16 mo.
	4	F	42	Hi. School	14 mo.
	5	M	26	Hi. School	16 mo.
Group 2	6	M	32	College	8 mo.
(TM+No AT)	7	F	42	Hi. School	12 mo.
	8	F	34	College	14 mo.
	9	M	26	College	N. A.
Group 3	10	M	30	College	N.A.
(No TM+AT)	11	M	28	College	N.A.
	12	M	29	College	N.A.
	13	M	42	College	N.A.
Group 4	14	M	28	College	N.A.
(No TM+No AT)	15	M	28	College	N.A.
	16	F	26	College	N.A.

C. EXPERIMENTAL PROCEDURES.

All of the subjects in the four groups were given a pretest using the Myers-Briggs Type Indicator questionnaire for personality type classification. Exactly three weeks later, all the subjects were given the same questionnaire again. A detailed description of the criterion measures was given earlier in the paper.

In the intervening three weeks, the people in all groups continued with their regular work. The subjects in the experimental groups, however, participated in the meditation exercise and/or alpha production training at the Human Engineering Laboratory. The training period involved twelve 50-minute sessions. Each session included 25 minutes for wiring. The length of the meditation and/or alpha training was 20 minutes and the length to record the basal % of alpha was 5 minutes.

The wiring consisted of placing the three electrodes in the proper place of the head. One electrode was placed at the lower part of the left (or right) ear; one was placed one inch to the left (or right) of the parieto occipital lobe, and one at one inch to the left of the occipital lobe.

In order to see if there is any difference in the % of alpha from the left or the right side of the brain, the electrodes were alternatively, each session, placed on the left then the right hemisphere. The base line alpha of each subject was measured before they were told to begin their meditation and/or alpha training.

The brain waves of each subject were recorded by the pen recording of a Beckman RM recording machine. The percentage of alpha wave of each subject was measured by the experimenter after each session. First the investigator has the experimenter differentiate which part on the recording paper represents alpha wave by counting the number of cycles per second, where alpha equals 7-13 cps. Then he measured the time percentage of alpha produced. This is the number of minutes of alpha wave recorded during one session of 20 minutes.

During their alpha training sessions, the subjects sat in a sound-attenuated, lightproof room. Communication between subject and experimenter was obtained via an intercom. In order to let the TM subjects practicing their transcendental meditation during their training time, they must be left completely sealed from the outside world. Their alpha production can only be trained by an indirect method by letting them study their recorded brain wave after each session. They were then asked to try to recall their state of mind during their meditation period, identifying it with the time their brain produced alphawave. Since most of the transcendental meditators produce a rather substantial amount of alpha wave during their meditation, it is not so difficult for them to identify their state of mind with the time when their brain emits alpha waves.

The TM subjects were asked to practice their usual meditation exercise as soon as the experimenter finished recording their alpha base line.

The non TM subjects, on the other hand, were instructed concerning the signal given by the experimenter through the intercom. They were then

told to sit still for about five minutes while their base line brainwave was recorded. After that, they were told to keep their eyes closed, try to relax, and that a sound would occur when they produced alpha. They were asked to maintain the same state they were in when the sound was heard.

After each training session, all subjects, TM and non TM were shown their recorded brain waves. They were asked by the experimenter how they felt and how they controlled their state of mind, etc.

D. RESULTS.

Percent of alpha produced per subject/day are given in Table as follows:

TABLE IV

% of alpha produced per subject/day

% alpha training/base line

	Day		1	2	3	4	5	6
	Subject	Av. of % alpha						
Meditator	1	71	78/43	67/50	65/51	72/60	70/60	75/62
	2	61	53/40	50/40	56/42	60/45	55/42	63/45
	3	55	48/36	55/42	52/40	55/42	58/46	52/46
	4	52	40/30	46/32	50/35	46/37	53/40	50/40
Non Meditator	5	12	5/4	9/6	6/6	11/10	4/8	12/8
	6	61	40/30	52/36	56/40	50/40	62/50	67/51
	7	21	8/5	4/3	12/6	12/6	19/7	22/10
	8	53	31/20	43/25	41/25	53/35	55/40	50/40

		% alpha training/base line						
	Day	Aver. of	7	8	9	10	11	12
	Subject	% alpha						
Meditator	1	71	68/60	78/65	82/66	80/67	85/70	88/70
	2	61	58/44	65/48	67/50	62/50	70/52	72/53
	3	55	51/45	57/47	55/46	59/50	62/50	61/52
	4	52	55/42	51/40	58/42	54/42	60/46	57/46
Non Meditator	5	12	15/8	11/9	18/10	22/12	20/15	28/15
	6	61	40/30	52/36	56/40	50/40	62/50	76/63
	7	21	20/10	26/12	25/12	32/15	30/15	38/17
	8	53	31/20	43/25	41/25	60/50	65/52	69/57

The % alpha given in Table above consists of two numbers:

- the number in the numerator is the average % of alpha produced per subject/day during their training period.

- the number in the denominator represents their daily % alpha of the base line. For example, meditator subject #1 has an overall average of 71% alpha. On the 7th day, he had 68% of alpha, and 60% of alpha as base line (with respect to time).

From Table IV we can see:

- there is a net difference in the % lf alpha of the base line of the two groups. TM subjects give a higher base line of % alpha than non TM subjects, i.e., TM subjects allow a higher level of alpha.

- there is a net difference in the % of alpha produced by meditators and non meditator subjects: Meditator subjects produced a much higher average % of alpha than non meditator subjects. This confirms hypothesis 3 (Meditation will allow higher alpha production). However, the average %

of alpha produced per subject shows that for these two groups, some non meditator subjects, on the average, produced more alpha than some meditator.

The results of an analysis of variance of the results taken from the Myers–Briggs Type Indicator test, both before and after the experimental time (Table IV in the Appendix) are as follows:

Analysis of Variance for Personality Type (Pre-Test)

Source of Variation	Degree of Freedom	Sum of Squares	Mean Square	F	p
Meditation	1	27722	27722	6.77	.02
Alpha Train.	1	17822	17822	4.35	.1
Med. X Alpha	1	319	319		
Error	12	4095	341.25		
Total	15	95010			

Analysis of Variance for Personality Type (Post-Test)

Source of Variation	Degree of Freedom	Sum of Squares	Mean Square	F	p
Meditation	1	50175	50175	13.97	.005
Alpha Train.	1	3843	3843	1.06	
Med. X Alpha	1	363	363		
Error	12	3593	299.42		
Total	15	97495			

Thus, the Analysis of Variance for Personality Type shows that:

- for the pretest results, there is a significant relationship between TM and personality (hypothesis 2). The F value is significant at the 0.02 level. Thus hypothesis 2 is confirmed.
- for the posttest results, however, the confirmation of hypothesis 2 is strengthened as the F value now is significant at the 0.005 level. On the other hand, hypothesis 4 is now rejected as the F value is not significant at the 0.1% level. This result should not surprise us because, as stated in the procedure section of the experiment, the TM subjects were just trained to control their alpha production indirectly.

Table IIIb in the Appendix shows us that:

- 6 out of 8 TM subjects are introverted type. This confirms our hypothesis 1 (positive correlation between TM and introversion).
- there are two changes in personality type, one from ENFP type to ENFJ type, the other from ENFP type to INFP type. This change seems to be due to the transcendental meditation since these subjects are TM not participating in the alpha production training. Thus, this confirms hypothesis 2 (positive correlation between TM and personality type).

E. DISCUSSION.

1. Meditation and Alpha Production.

The confirmation of our hypothesis 3 (TM allows higher alpha production) is just further support of the many similar results found by different researchers (Kamiya, 1967, 1968; Wallace, 1970; Green, Walters, Green, 1971).

M. Mahesh Yogi stated (D. Goleman, 1971): "the state produced by TM seems to be distinct from commonly encountered states of consciousness such as wakefulness, sleep, and dreaming, and from altered states of consciousness, such as hypnosis and autosuggestion." This, in conjunction with the reported state of pleasant relaxation of subjects in Kamiya study (Biofeedback and Self Control, 1971), seems to explain the physiological change which enhances the production of alpha wave.

2. Meditation and Introversion

Although the responses on the Myers-Briggs Type Indicator test gave us 6 out of 8 TM subjects who are introverted, the most that can be said is that with this group of meditators, there is a positive correlation between TM and introversion. It should be understood throughout the use of the MBTI that there must be no intent to claim that all persons classified by the Indicator as a given type actually are that type. Even if the items and scoring are perfect, there would still be errors in classification, since in any sample some people will report a preference incorrectly, whether by accident or by design.

We also have to remember that in order to say that meditation is related to introversion, we should have the historical personality backgrounds of the subjects before, during and after they practice TM. The length of practice time of TM certainly is an important factor influencing the type personality of the subject. Also recall Jung's concept of interaction among the systems of personality when he stated (p. 3):

"Compensation may be illustrated by the interaction of the contrasting attitudes of extraversion and introversion. If extraversion is the dominant or superior attitude of the conscious ego, then the unconscious will compensate by developing the repressed attitude of introversion. This means that if extraverted attitude is frustrated in some way, the unconscious inferior attitude of introversion will seize hold of the personality and exert itself."

Thus it could have happened that the introverted attitude of some of the TM subjects is just their inferior attitude. The superior attitude of these subjects is extraversion.

3. Meditation and Personality.

The relation between meditation and personality can be best understood by recalling the psychophysiological principle (Green et al, 1970):

"Every change in the physiological state is accompanied by an appropriate change in the mental-emotional state, and conversely, every change in the mental-emotional state, conscious or unconscious, is accompanied by an appropriate change in the physiological state."

In meditation, the psychophysiological principle can be used to understand the significance of "unstressing," a term used by practitioners of TM. Unstressing takes the form during meditation of completely involuntary, unintended, and spontaneous muscular-skeletal movements and proprioceptive sensations: internal pressures, headaches, weeping, laughter, etc. The experience covers the range from extreme pleasure to acute distress (Luk, 1966). In TM, unstressing is gradual during regular daily meditation, so that it is not always discernible. The fundamental assumption in understanding the function of unstressing is, as in psychoanalytic thought, that all past experience leaves its mark on present behavior

(D. Goleman, 1971). This is exactly Jung's view of man in combining teleology with causality. Jung wrote: "Both the past as actuality and the future as potentiality guide one's present behavior" (Hall and Lindzey, 1960).

4. Alpha Production and Personality.

Recall that hypothesis 4 (positive correlation between alpha production and personality) has been rejected by the analysis of variance of the posttest results. As stated earlier, there is no formal alpha training required upon the TM subjects and although the analysis of variance using the total score of each subject gave us no correlation between alpha production and personality, the analysis subject-by-subject did indicate that:

- there are two cases of personality type changes among 4 TM subjects with alpha training (Table IIIb) and another two cases of personality type change among the 4 TM who did not participate in the alpha training periods (Table IIIB). Also, there were two cases of personality type changes among the non meditator + alpha training subjects (Table IIIb). All these findings indicate that there might be a positive correlation between alpha production and personality.

III. SUGGESTIONS FOR FURTHER STUDIES

a. In order to obtain a net effect of alpha production over personality type, it seems that a longer period of alpha training is likely needed.

b. In order to obtain a better understanding about the relation between meditation and personality, in addition to the alpha training, we can perform measurements of heart rate, skin temperature changes, respiration rates and oxygen consumption.

c. In order to gain more confidence in the validity of the Myers-Briggs Type Indicator, one or more similar type of test could be given to the subjects along with the MBTI test. Those similar type of tests could be: The Personal Orientation Inventory, the Edward Preference Schedule, the California Personality Inventory, etc.

d. A larger sample size is needed in order to gain more confidence in the results of the experiment.

e. In case of using the MBTI, it is suggested that the composition of our sample population should be classified according to their educational level, professional background, age, rather than just the overall meditation class or alpha training class. This would give us a better understanding of personality type of the subjects.

f. Better equipment to measure direct % of alpha production should be provided.

g. In order to save time, to give more comfort to the subject, to obtain more effective results in registering the brain wave, better equipment is needed to put the electrodes on the subject's head.

APPENDIX A

TABLE III. Frequency and Mean Strength of the Preferences in Various Groups

		Preference for E		Preference for I		Preference for S		Preference for N	
		%	Mean E Score	%	Mean I Score	%	Mean S Score	%	Mean N Score
MALES									
Jr. High School									
Pre-prep 7th-8th	100	68%	16.9	32%	17.8	72%	19.7	28%	14.9
Gifted 7th-9th	34	50%	17.5	50%	19.9	21%	20.1	79%	29.1
Sr. High School									
Vocational 12th	701	52%	20.2	48%	18.2	85%	26.6	15%	10.7
General 12th	148	64%	20.3	36%	18.1	81%	25.0	19%	12.8
Academic 12th	325	62%	23.1	38%	18.3	60%	21.7	40%	19.5
National Merit Finalists	100	42%	20.2	58%	25.6	17%	19.6	83%	30.5
College									
Finance & Comm.	488	70%	22.8	30%	16.6	72%	26.6	28%	16.0
Liberal Arts	2177	54%	21.6	46%	21.5	38%	21.9	62%	25.3
Engineers	2389	48%	21.2	52%	22.5	33%	19.5	67%	26.0
Adult									
College graduates, industry-hired	350	65%	25.4	35%	19.4	50%	22.6	50%	21.0
School Admin.	124	59%		41%		58%		42%	
Creative men	115	37%	17.0	63%	23.4	3%	4.3	97%	31.8
FEMALES									
Jr. High School									
Pre-prep 7th-8th	121	75%	21.1	25%	15.9	70%	20.5	30%	15.2
Gifted 7th-9th	26	58%	26.5	42%	14.6	12%	17.0	88%	22.5
Sr. High School									
Vocational 12th.	573	61%	22.3	39%	19.7	88%	26.9	12%	11.5
Academic 12th	273	68%	25.3	32%	20.0	63%	21.4	37%	19.2
College									
Liberal Arts	241	58%	20.6	42%	19.6	30%	16.6	70%	26.4
Adults									
School Teachers	248	61%	20.6	39%	21.6	56%	24.4	44%	20.3
Creative Women	25	21%	17.3	79%	24.9	4%	23.3	96%	30.3

TABLE IIIa

Pretest and Posttest Preference Scores

on the Myers-Briggs Type Indicator

(Personality type expressed in total score)

GROUP 1 (meditation+alpha training)

Subject	Preference Score	
	Pretest	Posttest
S_1	421	412
S_2	504	524
S_3	524	482
S_4	554	512

GROUP 2 (non meditation+alpha tr.)

Subject	Preference Score	
	Pretest	Posttest
S_5	390	274
S_6	486	428
S_7	320	344
S_8	508	398

GROUP 3 (meditation+non alpha tr.)

Subject	Preference Score	
	Pretest	Posttest
S_9	416	420
S_{10}	422	378
S_{11}	480	492
S_{12}	452	478

GROUP 4 (non meditation+non alpha tr.)

Subject	Preference Score	
	Pretest	Posttest
S_{13}	438	430
S_{14}	298	296
S_{15}	295	282
S_{16}	372	350

TABLE IIIb

Pre and post test results for Group 1,

from the Myers-Briggs Type Indicator.

(Personality type expressed in preference and total scores.)

GROUP 1 : meditator + alpha training

Before alpha training

Subjects	1		2		3		4	
Preference Scores	I	17	I	43	I	5	I	35
	S	5	N	43	N	41	N	49
	F	17	T	29	F	21	F	20
	J	7	P	45	P	59	P	49
Personality Type	ISFJ	46	INTP	160	INFP	126	INFP	153

GROUP 1: meditator + alpha training

After alpha training

Subjects	1		2		3		4	
Preference Scores	I	17	I	43	I	5	I	33
	S	7	N	47	N	43	N	51
	F	29	T	23	T	39	T	1
	J	25	P	57	P	53	P	29
Personality Type	ISFJ	78	INTP	170	INTP	140	INTP	114

TABLE IIIb (continued)

Pre and post test results for Group 3
from the Myers-Briggs Type Indicator
(Personality type expressed in preference and total scores)

GROUP 3: non meditator + alpha training

Before alpha training

Subjects	1		2		3		4	
Preference Scores	I	23	I	33	E	3	I	29
	S	11	N	45	S	21	N	19
	T	3	T	29	T	27	F	19
	J	19	P	37	J	29	P	41
Personality Type	ISTJ	56	INTP	144	ESTP	80	INFP	108

GROUP 3: non meditator + alpha training

After alpha training

Subjects	5		6		7		8	
Preference Scores	E	27	I	25	E	3	I	5
	S	25	N	29	S	15	S	23
	T	35	F	3	T	5	F	5
	J	39	P	11	J	33	P	13
Personality Type	ESTJ	126	INFP	68	ESTJ	56	ISFP	46

TABLE IIIb (continued)

Pre and post test results for Group 2 from the
Myers-Briggs Type Indicator

(Personality type expressed in preference and total scores.)

GROUP 2: meditator + non alpha training

Before alpha training

Subjects	9		10		11		12	
Preference Scores	I	37	E	5	I	51	E	7
	S	17	N	25	N	41	N	17
	F	5	F	1	T	25	F	9
	J	9	P	1	P	13	P	33
Personality Type	ISFJ	68	ENFP	32	INTP	130	ENFP	66

GROUP 2: meditator + non alpha training

After alpha training

Subjects	9		10		11		12	
Preference Scores	I	15	E	1	I	55	I	7
	S	11	N	7	N	41	N	25
	F	13	F	3	T	17	F	1
	J	17	J	1	P	13	P	45
Personality Type	ISFJ	56	ENFJ	12	INTP	126	INFP	78

TABLE IIIb (continued)

Pre and post test results for Group 4

from the Myers-Briggs Type Indicator

(Personality type expressed in preference and total scores)

GROUP 4: non meditator + non alpha training

Before alpha training

Subjects	13		14		15		16	
Preference Scores	I	35	E	33	E	27	I	39
	N	9	S	23	S	37	S	51
	T	13	T	27	T	5	T	5
	P	5	J	19	J	39	J	11
Personality Type	INTP	62	ESTJ	102	ESTJ	108	ISTJ	106

GROUP 4: non meditator + non alpha training

After alpha training

Subjects	13		14		15		16	
Preference Scores	I	45	E	29	E	41	I	39
	N	5	S	28	S	33	S	47
	T	19	T	23	F	5	T	23
	J	3	J	25	J	29	J	19
Personality Type	INTJ	102	ESTJ	104	ESFJ	108	ISTJ	128

TABLE IV

Computation of the analysis of variance of the pre and post test results (Total score)

GROUP 1	GROUP 2	GROUP 3	GROUP 4
sum	sum	sum	sum
2003	1704	1770	1403

sum squares = 3,053,410

grand sum = 6,880

$(6880)^2$ = 47,334,400 = correction term

sum of square = 3,053,410 - 2,958,400 = 95,010

Effect of the first factor (the overall effects of transcendental meditation meditation versus non meditation)

2003 + 1770 = 3773 = sum of the TM groups

1704 + 1403 = 3107 = sum of the non TM groups

$\left(\frac{3773}{8}\right)^2 + \left(\frac{3107}{8}\right)^2$ = 1,779,441.1 + 1,206,681.1
= 2,986,122.2

Subtract it from correction term:

2,986,122.2 — 2,958,400 = 27,722.2 = SS meditation

Effect of the second factor (the overall effects of alpha training versus non alpha training)

Sum of alpha training

2003 + 1704 = 3707

Sum of non alpha training

1770 + 1403 = 3173

$\left(\frac{3707}{8}\right)^2 + \left(\frac{3173}{8}\right)^2$ = 1,717,731 + 1,258,491 = 2,976,222

Subtract the correction term

2,976,222 — 2,958,400 = 17,822 = SS alpha

Computation of the interactive of meditation versus alpha training

$$\frac{(2003)^2}{4} = \frac{(1704)^2}{4} + \frac{(1770)^2}{4} = \frac{(1403)^2}{4}$$

$$= 1{,}003{,}002 + 725{,}904 + 783{,}255 + 492{,}102 = 3{,}004{,}264$$

From this, subtract the correction term, SS meditation, SS alpha

$$3{,}004{,}263 - 2{,}958{,}400 - 27{,}722 - 17{,}822 = 3{,}004{,}263 - 3{,}003{,}944 = 319$$

$$= \text{SS med x alpha}$$

Computation of the error term sum of squares (SS error)

SSt − SSmed − SS alpha − SSmed x alpha =

95,010 − 27,722 − 17,822 − 319 =

95,010 − 45,863 = 49,147 = SS error

df for SSt = Total number of measures minus 1

df for SSt = 16 - 1 = 15

df for SSmed = number of meditation status minus 1

= 2 - 1 = 1

df for SS alpha = number of alpha training status minus 1

= 2 - 1 = 1

df for SS med x alpha = df for SSmed times df for SS alphs

= 1x1 = 1

df for SS error = the df for SSt minus df for SS med, SS alpha and SS med x alpha

= 15 - 1 - 1 - 1 = 12

The mean squares computed as SS/df

$$\text{ms med} = \frac{\text{SSmed}}{1} = 27{,}722$$

$$\text{ms alpha} = \frac{\text{SS alpha}}{1} = 17{,}822$$

$$\text{ms med x alpha} = \frac{\text{SS med x alpha}}{1} = 319$$

$$\text{ms error} = \frac{\text{SS error}}{12} = 4{,}095$$

The several F ratios are then computed as follow:

$$\frac{\text{ms med}}{\text{ms error}} \qquad \frac{\text{ms alpha}}{\text{ms error}} \qquad \frac{\text{ms med x alpha}}{\text{ms error}}$$

Source	SS	df	ms	F	P
total	95010	15	—	—	—
meditation	27722	1	27722	6.77	sig<0.02
alpha training	17822	1	17822	4.35	sig<0.1
med x alpha	319	1	319	0.078	n.s.
error	4095	12	4095		

Similarly, the two-by-two analysis of variance for the post test results gives us:

source	SS	df	ms	F	P
total	97495	15	—	—	—
meditation	50175	1	50175	13.97	sig<0.005
alpha training	3843	1	3843	1.06	n.s.
med x alpha	363	1	363	0.10	n.s.
error	3593	12	3593		

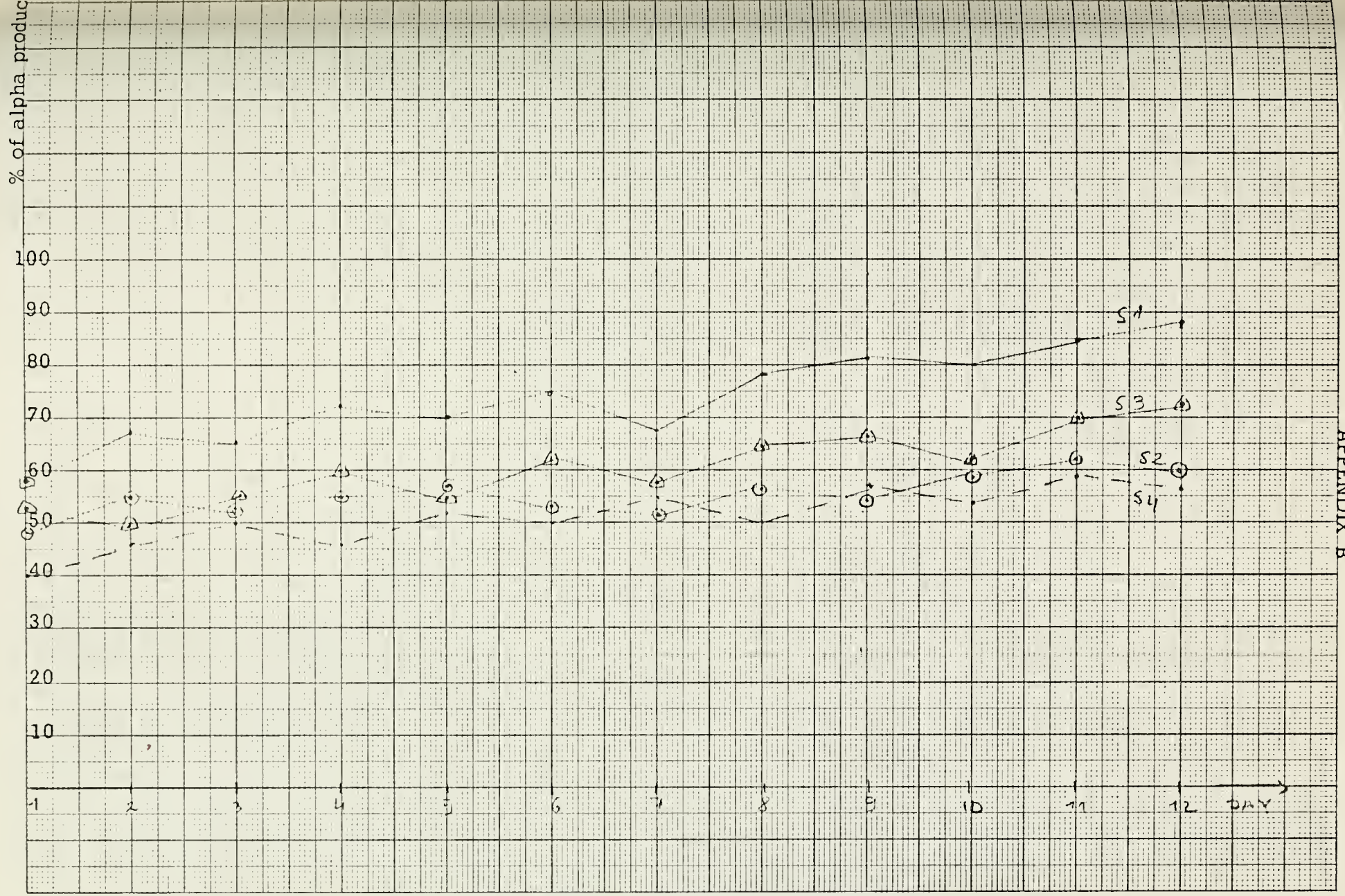

Figure 1. % of Alpha Production by Meditators.

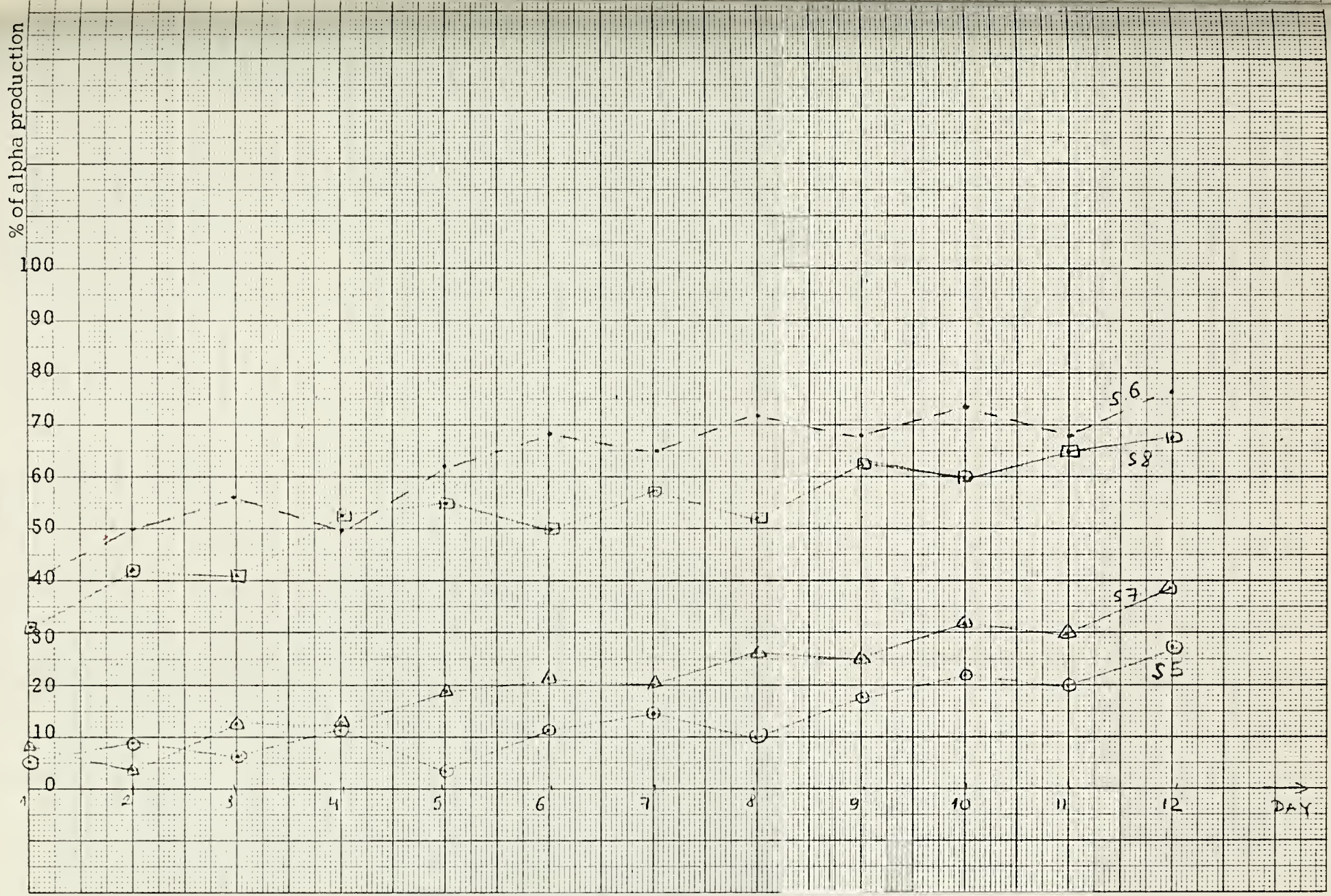

Figure 2. % of Alpha Production by Non-Meditators.

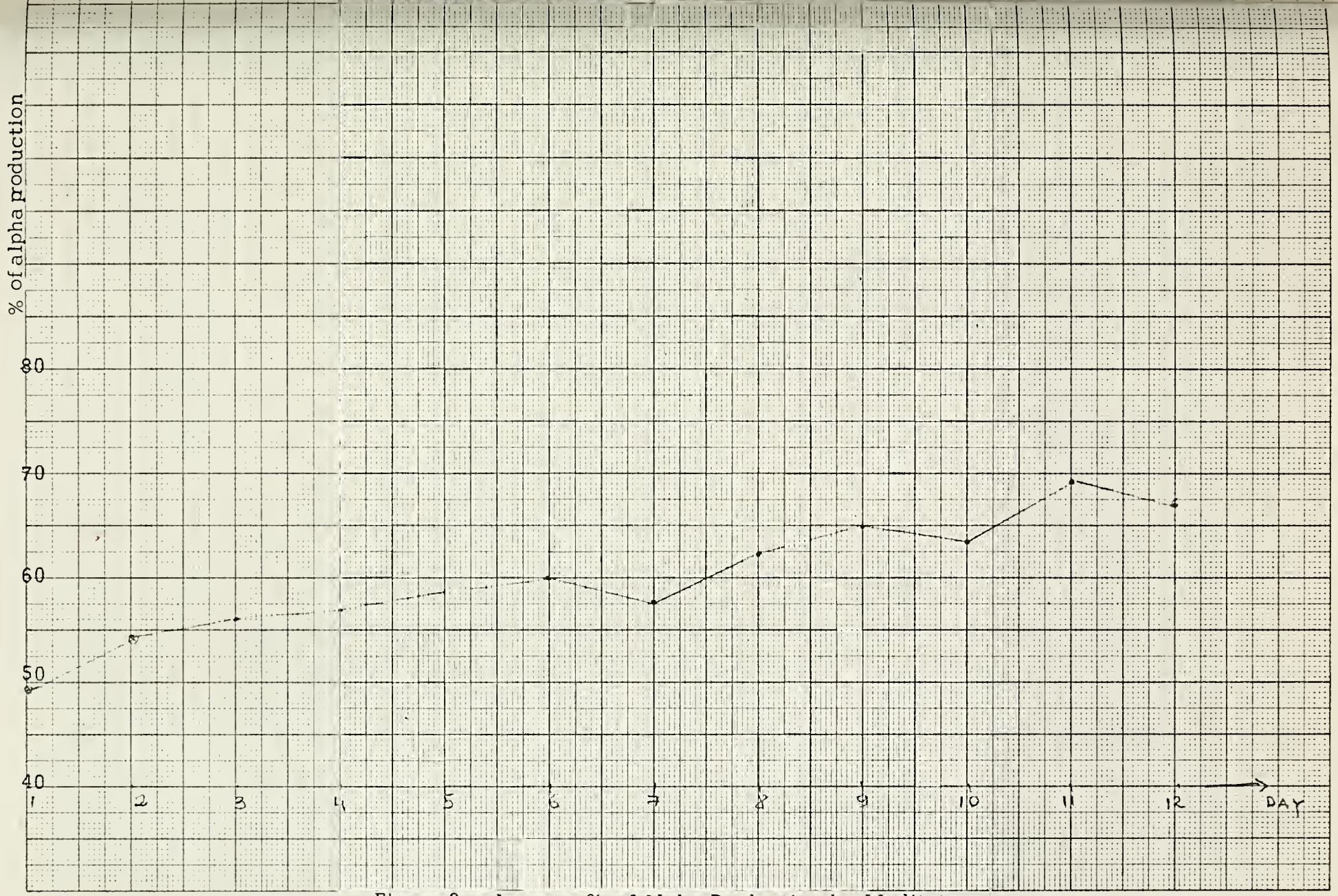

Figure 3. Average % of Alpha Production by Meditators.

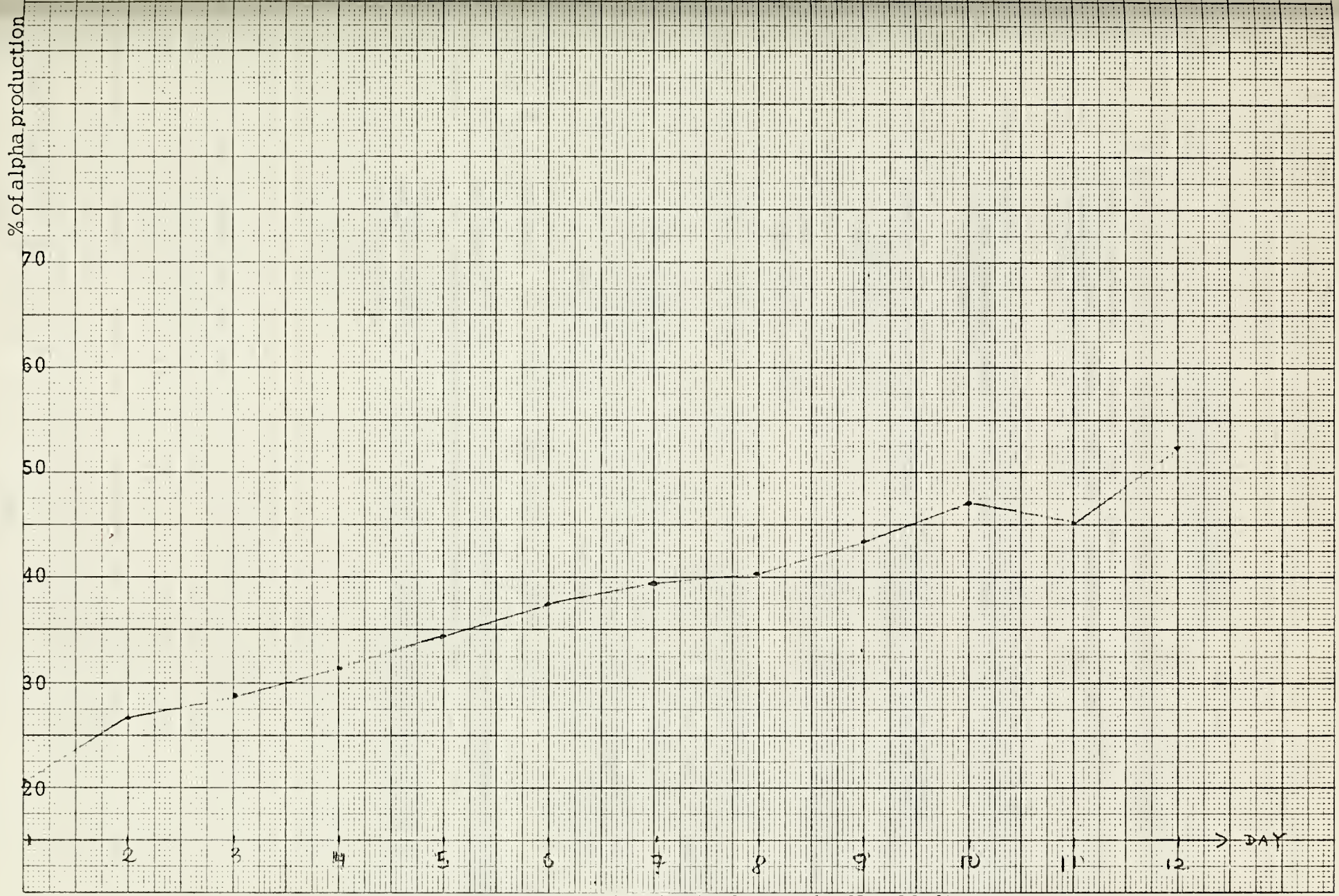

Figure 4. Average % of Alpha Production by Non Meditators.

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In recent years scientists in every nation have come to realize that voluntary control of behavior is of primary importance if we hope to establish an ordered society or even to maintain a society.

Meditation has been known and practiced by Asian people, especially Indians, for many hundreds of years. With the aid of the biofeedback technique, it is believed that the study of altered states of consciousness, creativity,

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parapsychology, personality type, psychosomatic medicine, therapy, and education, etc., could be greatly enhanced.

This paper is concerned with the interrelationship among meditation, personality type and brain wave production using biofeedback techniques.

Emphasis is placed on the effect of meditation on personality type changes.